SERVICE INFORMATION

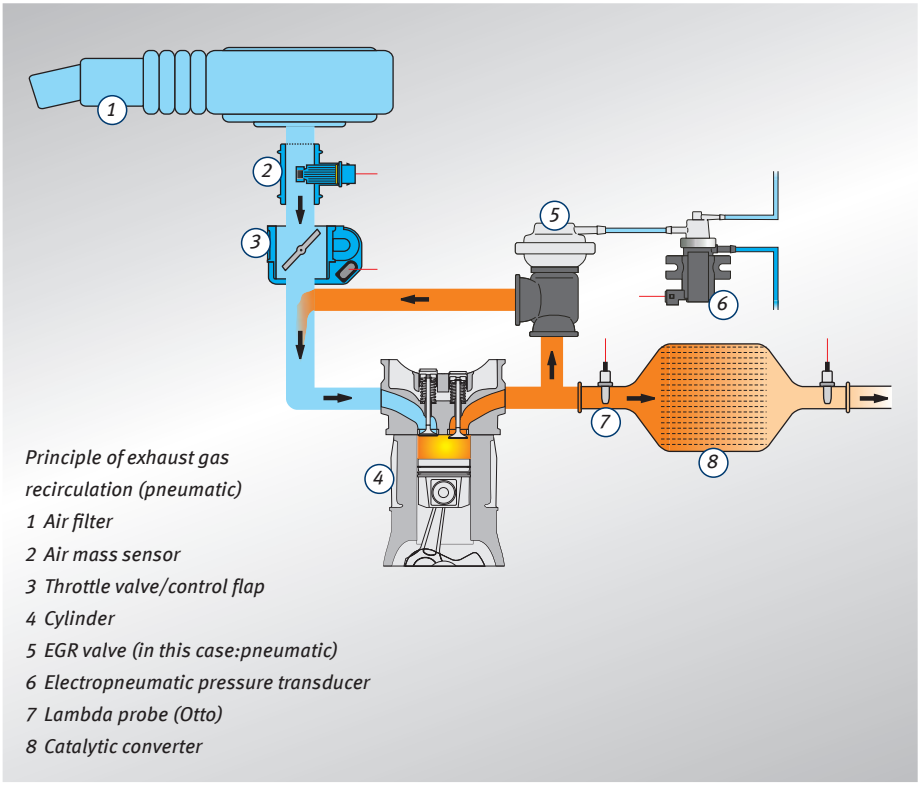
Troubleshooting in exhaust gas recirculation system

on Otto and diesel engines

Vehicle	Products
all vehicles equipped with exhaust gas recirculation system	Pos. 2, 3, 5, 6, 7 (see figure)

Exhaust gas recirculation (EGR) is a reliable and practice-proven method of emission control:
As a result of exhaust gas, the oxygen content in the air-fuel mixture is reduced, and consequently the combustion temperature in the cylinders lowered.
Since harmful nitrogen oxides (NO_x) are mainly produced at high temperatures and pressures, it is possible to reduce the NO_x concentrates emitted to the environment by up to 50%.
On diesel engines, the formation of soot particulates is lowered by approx. 10%.
Exhaust gas recirculation is only activated at defined operating points.
On petrol engines this is normally the case above idling and up to upper part load, on diesel engines up to approx. 3000 rpm and medium load.

Tips for troubleshooting see page 3 and 4



Principle of exhaust gas recirculation (pneumatic)
1 Air filter
2 Air mass sensor
3 Throttle valve/control flap
4 Cylinder
5 EGR valve (in this case:pneumatic)
6 Electropneumatic pressure transducer
7 Lambda probe (Otto)
8 Catalytic converter

EGR at a glance	Diesel engine (all injection types)	Petrol engine (manifold injection)	Petrol engine (direct injection)
Effects	Nitrogen oxides -50% Particulates -10% Less hydrocarbons emitted Less noise emitted	Nitrogen oxides -40% Fuel consumption -3% Less CO_2	Nitrogen oxides -50...60% Fuel consumption -2% Less CO_2
Return rates	Max. 65%	Max. 25%	Max. 50% (with stratified charge) Max. 30% (with homogenous operation)
Others	EGR cooling is required for vehicles with higher weight class	EGR cooling under discussion	High EGR rates at high load

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Text and illustrations subject to change.

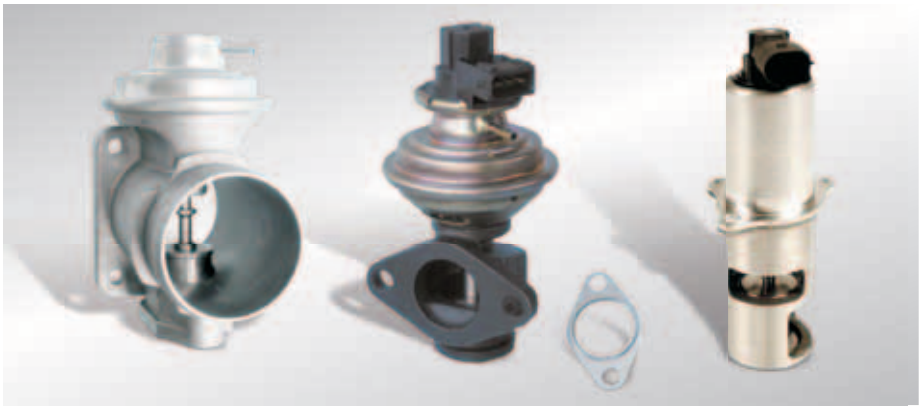
Replacement for SI 0038, SI 0039

Components of exhaust gas recirculation system (EGR)

The EGR valve meters the amount of recirculated exhaust gas.
It is added either at the exhaust manifold or at the intake air system, or it is located in a heat-resistant exhaust-gas pipe which connects the exhaust manifold to the intake air system.

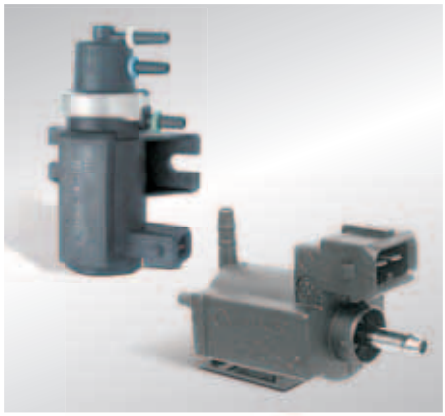
Pneumatic EGR valves are actuated by way of vacuum via electromagnetic valves:
On basic systems with an electric switchover valve, the EGR valve only has an open-close function.
On systems provided with an electro-pneumatic pressure transducer (EPW), the EGR valve is infinitely adjustable.
The vacuum is taken from the intake manifold or generated by a vacuum pump.

Electric or electromotive EGR valves are actuated direct by the control unit and no longer need any vacuum or solenoid valve.



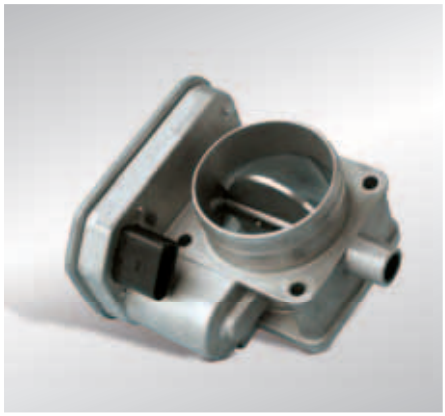
EGR valves on diesel vehicles have large opening cross-sections because of their high return rates.
Left: Pneumatic EGR valve
Centre: Pneumatic EGR valve with position detection
Right: Electric EGR double-seat valve

On EGR valves in petrol engines, the cross-sections are considerably smaller.
Left: Electric EGR valve with connection to the coolant circuit
Centre: Pneumatic EGR valve
Right: Electric EGR valve



Pneumatic EGR valves are actuated with the aid of electro-pneumatic valves.

The air mass sensor is required on diesel engines, among other things for controlling the exhaust gas recirculation.



Since the pressure difference between exhaust and intake side is inadequate for the high exhaust gas recirculation rates on diesel vehicles, "regulating throttles" are fitted into the intake manifold to generate the required vacuum.

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Tips for troubleshooting

The most common cause for malfunctions in the EGR system are stuck or carbonised EGR valves. Besides gaseous pollutants, recirculated exhaust gas also contains soot particulates, in particular in the case of diesel vehicles.
Due to oil in the intake air, carbon deposits or carbon fouling are caused which eventually the force of the valve can no longer cope with ñ the EGR valve can then no longer open, or it remains in its open position.
This results in jerking, irregular idling or insufficient engine power.

The causes of a high portion of oil in the intake or charge air may be malfunctions in the crankcase ventilation, worn bearings, a clogged oil return line on the turbocharger, worn valve stem seals or guides, the use of unsuitable engine oil qualities or an excessive engine oil level.

Exceptionnally intense deposits may also be caused by faults in the injection system.

Though EGR valves are designed for the high temperatures in the exhaust branch system, heat damage to the valve may occasionally occur.
Such damage can be caused by incorrect actuation, excessively high exhaust gas back pressure or a blow-off valve ("waste-gate valve") of the turbocharger which does not open. There may even be some manipulation ("tuning") to increase the boost pressure.

On pneumatic EGR valves, one potential cause of malfunctions can be found in the entire section of vacuum control (vacuum pump, vacuum lines, solenoid valves).

Electric EGR valves and solenoid valves can mostly be actuated by way of an actuator diagnosis by the engine tester.

The switching of a functioning valve can easily be heard when the engine is at a standstill.

Whenever a new EGR valve is installed after a defect, and the vehicle behaves as if the valve had not have been replaced at all, the map data required for operation must first be "re-learnt".
This is achieved either in the course of a longer test drive or by using a specific program option in the engine tester, e.g. "Basic settings".

We strongly advise against cleaning the EGR components!
If a component really is already defective, **no improvement** will be achieved by cleaning it.
And if functioning components are treated in this way, they may be **damaged** as a result of cleaning.
A defective component should always be replaced by a new one.

Since EGR valves do not soot themselves, it is essential to search for the causes of soot formation.

Salt and dirt may damage the sensor of an air mass sensor – they will at least falsify the measurements, which in turn could affect exhaust gas recirculation.

Whether dealing with pneumatic EGR valves or an electro-pneumatic pressure transducer, as in this case: The function can easily be tested using a vacuum hand pump.

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Troubleshooting in exhaust gas recirculation system

Complaint	Potential causes	Remedies
Caused by EGR valve		
• Irregular idling • Jerking • Insufficient engine power • Limp-home operation • MIL lights up/error code set • Insufficient engine power in lower rpm range or in cold run (Otto) • Insufficient engine power in upper rpm range (diesel)	• General: Coked/stuck EGR valve - Poor, inadequate combustion - Engine management fault - Frequent short-distance drives - Leaks in vacuum system	• Check engine controls • Check software update of engine control unit • Avoid frequent short-distance drives • Replace valve
	• Defective solenoid valves • Malfunctions in vacuum system	• Check function, electrical actuation and tightness of vacuum system See below: "Vacuum system"
	• High oil content in intake or charge air: - Malfunctions in crankcase ventilation - Engine oil level too high - Low-quality engine oil - Worn valve stem seal or guides	• Check oil separator, engine exhaust valve • Check pistons, piston rings, cylinders, valve stem seals and/or guides for wear • Check turbochargers for clogged oil return line • Change of oil and oil filter replacement (by professional)
	• Air mass sensor signal/other sensor signal defective	• Check sensors for set-point values, replace if necessary
• P0401 "Flow rate too low" • P0103 "Air mass too high"	• EGR valve does not open or is not actuated • EGR system has been shut down (the vehicle no longer complies with the ABE!)	• Check connectors and actuation
• P0402 "Flow rate too high" • P0102 "Air mass too low"	• EGR valve does not close/remains permanently open • Uncontrolled, permanent exhaust gas recirculation	• Replace EGR valve • Check connectors and actuation
• EGR valve has temperature damage, visible discolouration, initial fusing (Otto)	• Incorrect actuation • Exhaust gas back pressure too high • Blow-off valve of turbocharger does not open	• Replace EGR valve • Check actuator of EGR valve • Check exhaust gas back pressure • Check blow-off valve of turbocharger ("waste-gate") and its actuation
• New EGR valve, inoperative • High idling after installation	• New EGR valve has not been adapted	• Conduct a basic setting of EGR valve using the engine tester
Caused by vacuum system/solenoid valves		
• Engine "chattering" • Engine misfires • Limp-home operation • Decreasing braking performance	• Defective hoses (porous, damaged by marten bites) • Leaking connectors on pneumatic valves • Leaking non-return valves/vacuum reservoir • Defective/porous diaphragms or seals on pneumatic actuators • Leaks in intake manifold	• In the event of damage, check the tightness of all components in the vacuum system and replace defective part
Caused by air mass sensor		
• P0401 "Flow rate too low" • Black smoke • Inadequate engine performance • Limp-home operation	• Air mass sensor damaged/dirty due to - Dirt particles in intake air - Leaks in intake air system, splash water - Contamination during air filter replacement - Clogged air filters - Oil-moistened sports air filters	• Avoid any intake of water and particles into intake air system
	• Damage to turbocharger	• Check turbocharger

EGR = Exhaust gas recirculation; **MIL** = Malfunction Indicator Lamp

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